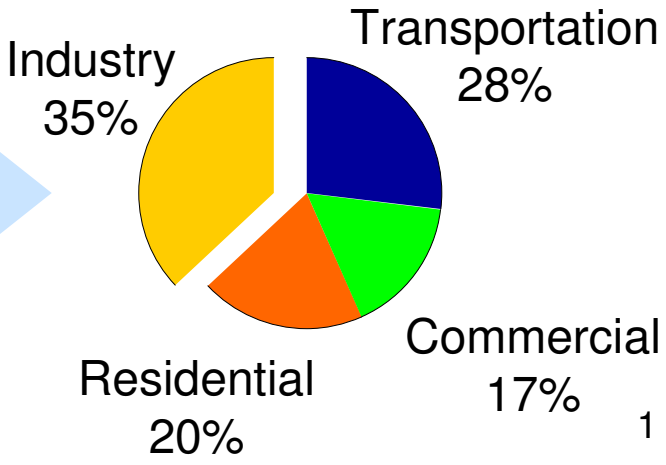
Industrial Technologies Program

GOALS

- ***Energy savings***
- Environmental quality
- Yield improvement/
  Resource conservation
- Economic viability
- Energy security

Targeting the largest opportunity to save energy in the United States

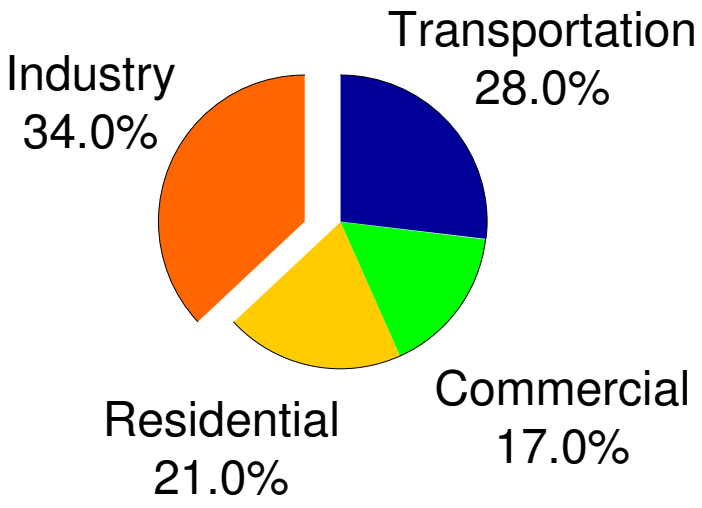
2001 Energy Use



Industry: Critical to National Energy Policy

- 1/3 of U.S. **energy consumption**
- Accounts for more than 40% of U.S. **natural gas** demand
- 28% of U.S. electricity demand
- Approximately 30% of U.S **greenhouse gas** emissions
- Energy is key to **economic growth** in domestic manufacturing

2004 Energy Use*



*Includes electricity losses

Source: DOE/EIA Monthly Energy Review 2004 (preliminary)

Industrial Technologies Program

MISION

Improve the energy intensity of U.S. industry through coordinated research and development, validation, and dissemination of energy efficiency technologies & practices.

Partner with industry and other stakeholders to:

- Increase energy savings
- Reduce environmental impacts
- Improve process yield/conserve resources
- Reduce reliance on foreign oil
- Increase use of renewable energy
- Improve competitiveness and quality of life

Delivering Technology Solutions

Collaborative R&D

- Energy-intensive industries (IOF)
- Crosscutting Technologies
- Grand Challenges

Partnerships

Technology Delivery

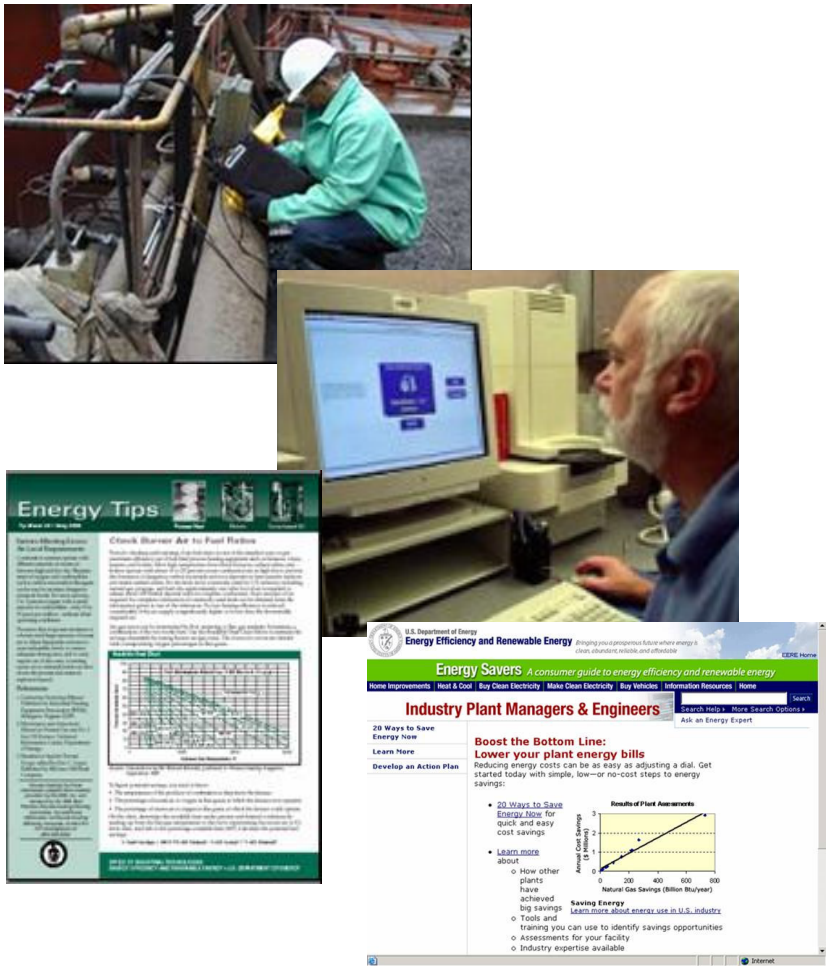
- Assessments
- Training & Tools
- Emerging Technologies
- Demonstrations

EERE Allied Partners:

- Enrich existing services to industrial plants by delivering EERE tools, training, information, technologies, and other opportunities for energy savings.
- Expand industry's access to EERE products and services.
- Work with EERE to develop case studies, training seminars, software tools, conference sessions, etc.

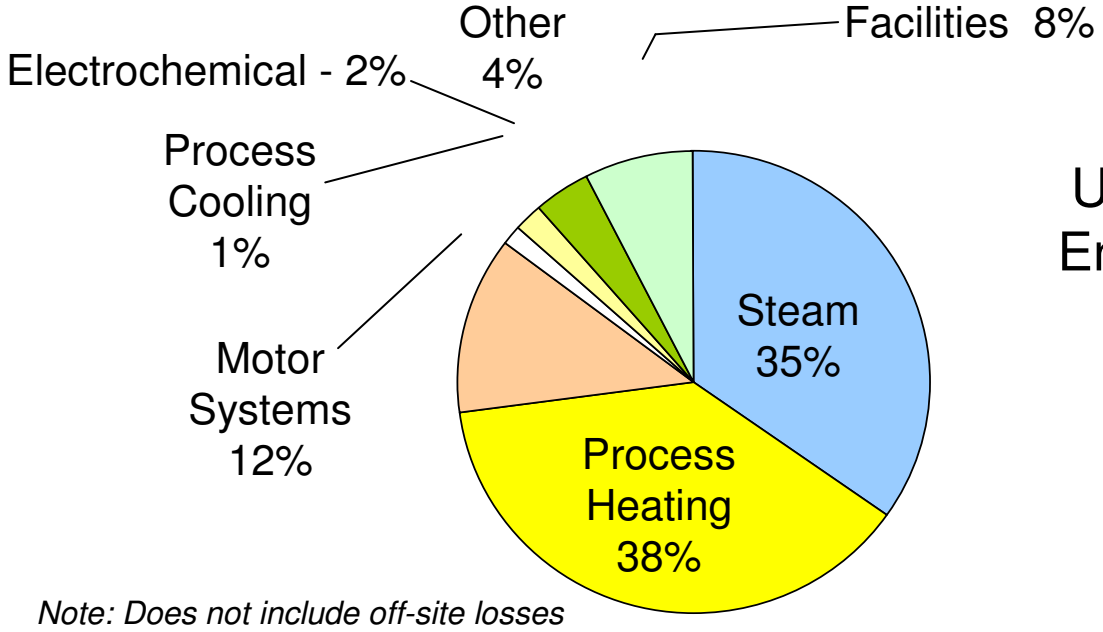
DOE Resources Available for Industry

- Assessments
- Software Tools
- Training
- Qualified Specialists
- Information
- Information Center
- Web Sites



Energy Savings Assessments

- By the end of 2007 DOE will have conducted 450 system assessments of large facilities, focusing on steam, process heating, compressed air, pump, and fan systems.
- Assessments done by teams composed of DOE Qualified Energy Experts and plant personnel
- Plant personnel and affiliates will be trained on DOE efficient tools
- Energy Savings Assessment Report identifies potential energy and cost savings and possible next steps



U.S. Manufacturing Energy Use by Type of System (%)

Note: Does not include off-site losses

"Easy Ways to Save Energy" Campaign

- A response to hurricanes Katrina and Rita and disruption in energy supplies
- DOE/Energy Efficiency & Renewable Energy (EERE) has created four initiatives

1. Energy Hog campaign – Public Service Announcements
2. Energy Savers tips to help homeowners save energy
3. Federal Energy Management Program (FEMP) energy saving teams
4. Industrial Energy Technologies (ITP) **"Save Energy Now"**

Industrial Assessment Centers

Qualification Criteria

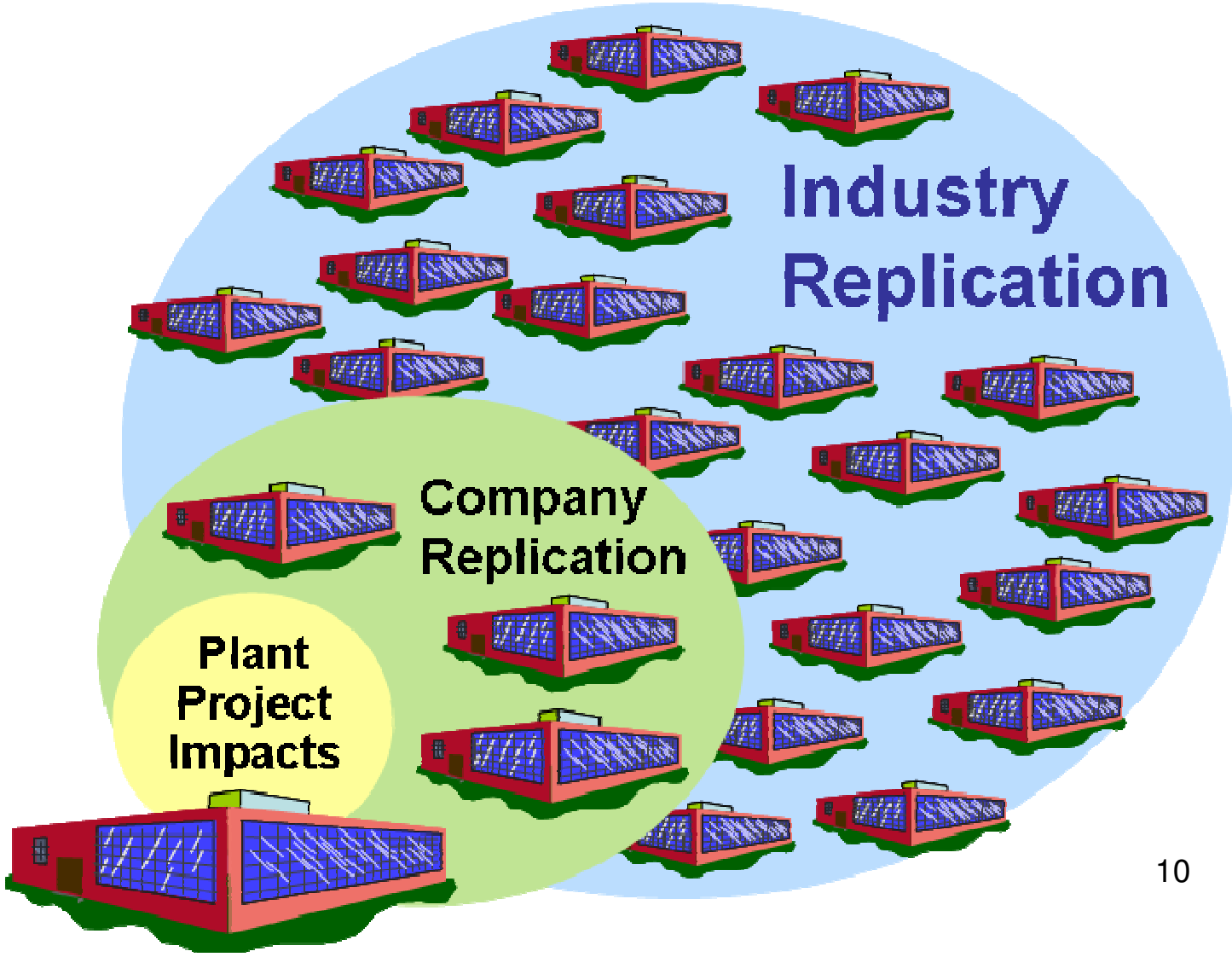
- Annual sales under $100 million
- 500 or less employees at plant
- No designated energy manager
- Energy bill less than $2 M/yr and greater than $100K/yr

- Plant located 150 miles or less from IAC school

Contact your nearest IAC university to request an assessment.

Visit: http://iac.rutgers.edu/database/

Replicating Assessment Savings



Tools Available on Our Web Site

- **Motor Master +** Assists in energy-efficient motor selection and management. (International)
- **Pumping System Assessment Tool** Assesses the efficiency of pumping system operations.
- **Fan System Assessment Tool** quantifies potential benefits of a more optimally configured fan system
- **Chilled Water System Assessment Tool** Assesses the efficiency of a chilled water system.
- **Air Master+** Provides comprehensive information on assessing compressed air systems.
- **ASDMaster** Determines economic feasibility of an ASD application.

Tools Available on Our Web Site

- **Steam System Scoping Tool** Profiles and grades large steam system operations/management.
- **Steam System Assessment Tool** Assesses potential benefits of specific steam-system improvements.
- **3EPlus Insulation Assessment Tool** Calculates most economical thickness of insulation for a variety of operating conditions.
- **Process Heating Assessment and Survey Tool** Assesses energy use in furnaces/ performance improvements
- **NOx and Energy Assessment Tool (NxEAT)** analyzes NOx emissions and energy efficiency improvements
- **Plant Energy Profiler** profiles plant energy supply along consumption streams and identifies energy savings opportunities

Training Opportunities for Software Tools

- Awareness Workshops (usually 1-2 hours)
- Webcasts (1-2 hours)
- End-user training (1-2 days)
- Qualified specialist training (2-3 days)
  - Potential resource for plant personnel

See www.eere.energy.gov/industry for details

Information

- Tip sheets, case studies, brochures, technical briefs etc.
- *Energy Matters* newsletter
- Industrial Technologies Monthly e-bulletin
- Software tools and training
- Web sites

http://www.eere.energy.gov/industrybestpractices/training.html

Energy Efficiency and Renewable Energy Information Center

On-call team of professional engineers, scientists, research librarians, energy specialists, and communications information staff

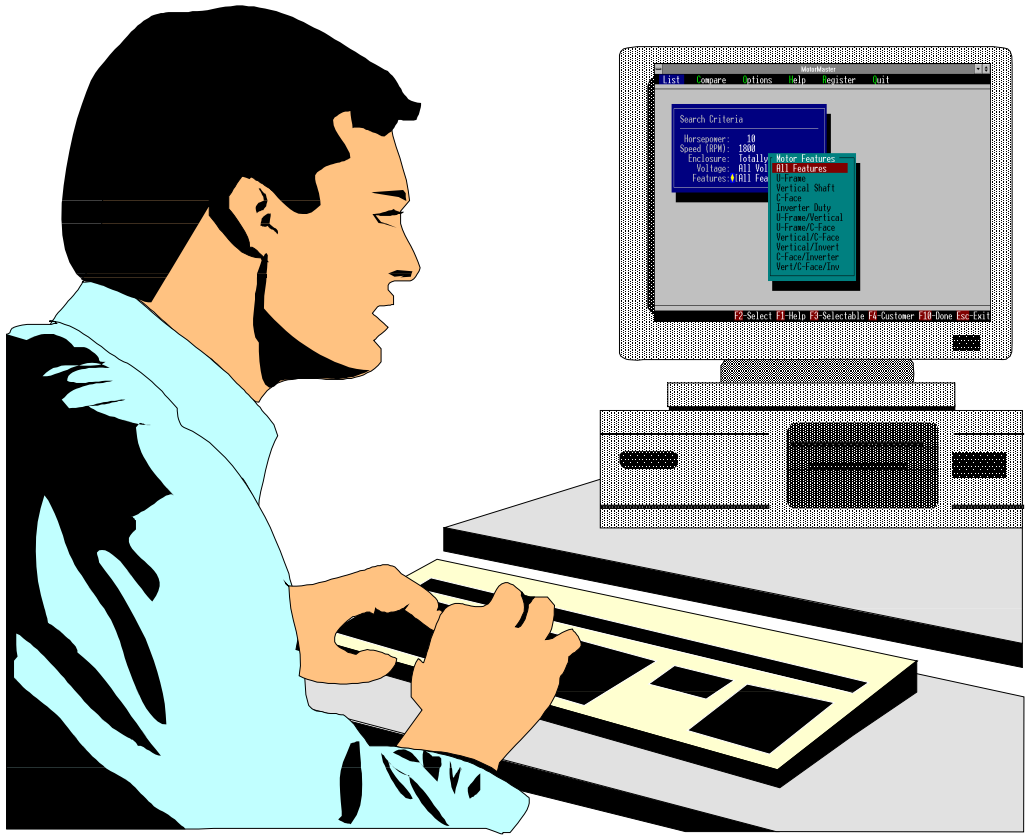
Voice: **877-337-3463**

Fax: **360-236-2023**

Email: **eerecsc@ee.doe.gov**

Website: **www.eere.energy.gov/informationcenter**

Motor Master Software



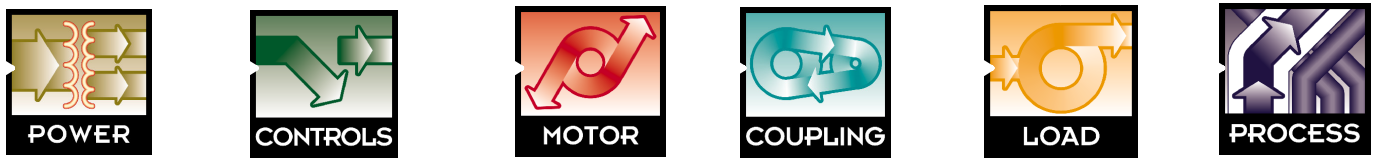
Will Help You With Motor Purchasing And Overall Motor Systems Management

What is a Motor System?

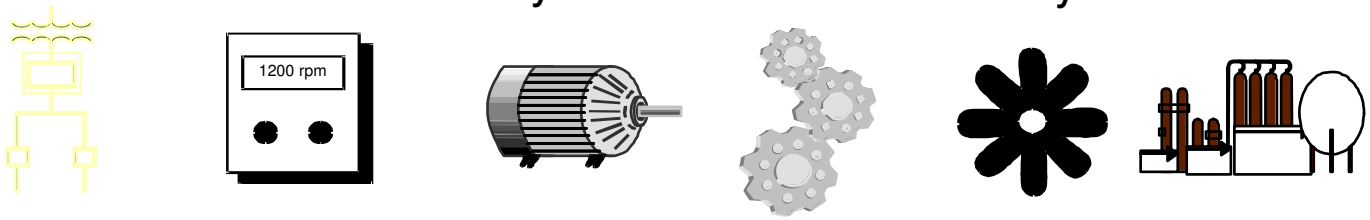
The Electric Motor System

Three-Phase Input Power

Process Mechanical and Electrical Feedback



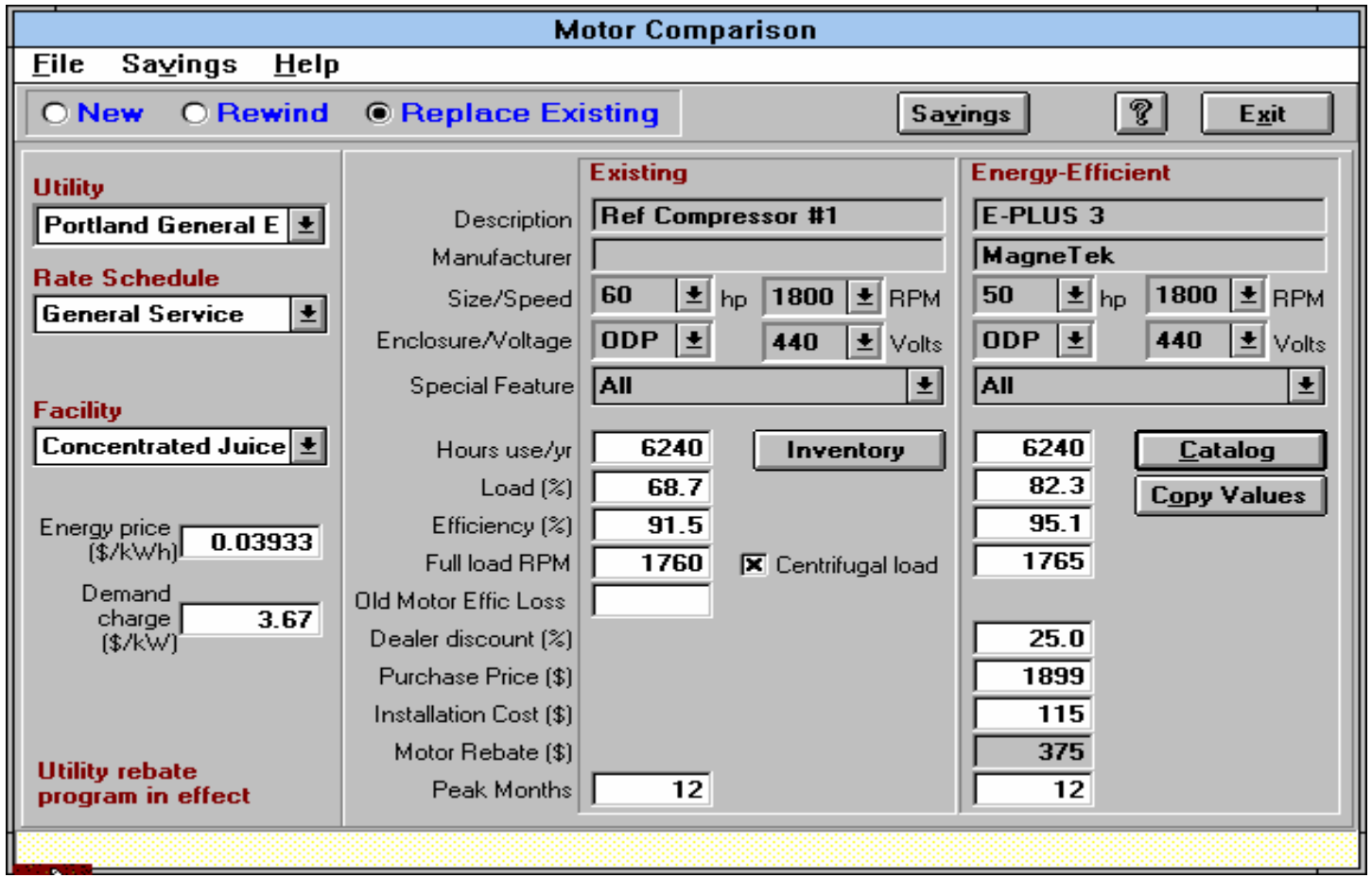
Motor/Drive Subsystem Mechanical Subsystem



MotorMaster+

- Runs on any Windows-based platform
- Requires at least 8 MB of memory and a hard disk with at least 10 MB of free disk space
- Easy to learn and use

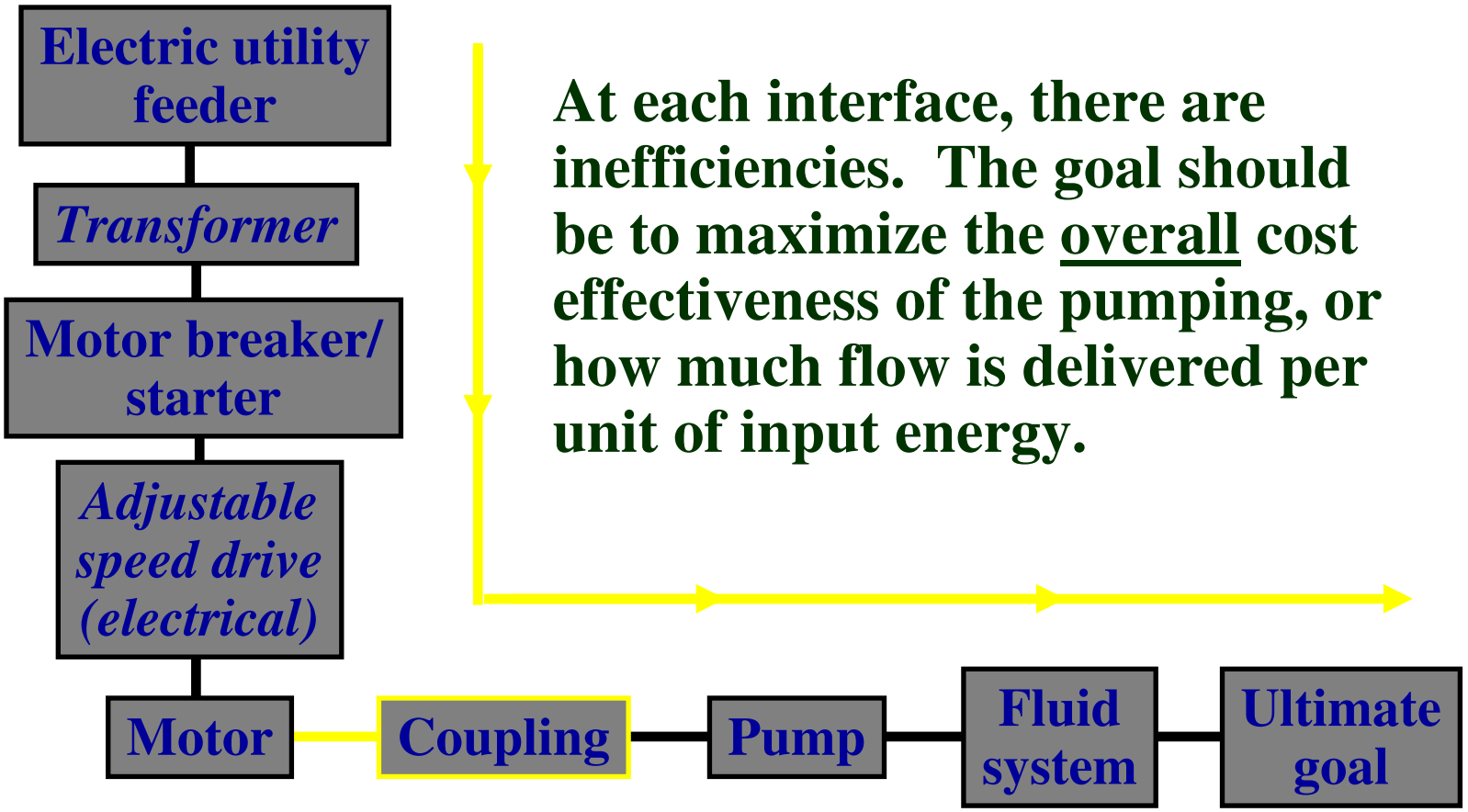
Motor Comparison: Replace Oversized Motor



Pumping System Assessment Tool

- Assesses the efficiency of pumping system operations.

Big picture perspective of energy flow for pumping systems



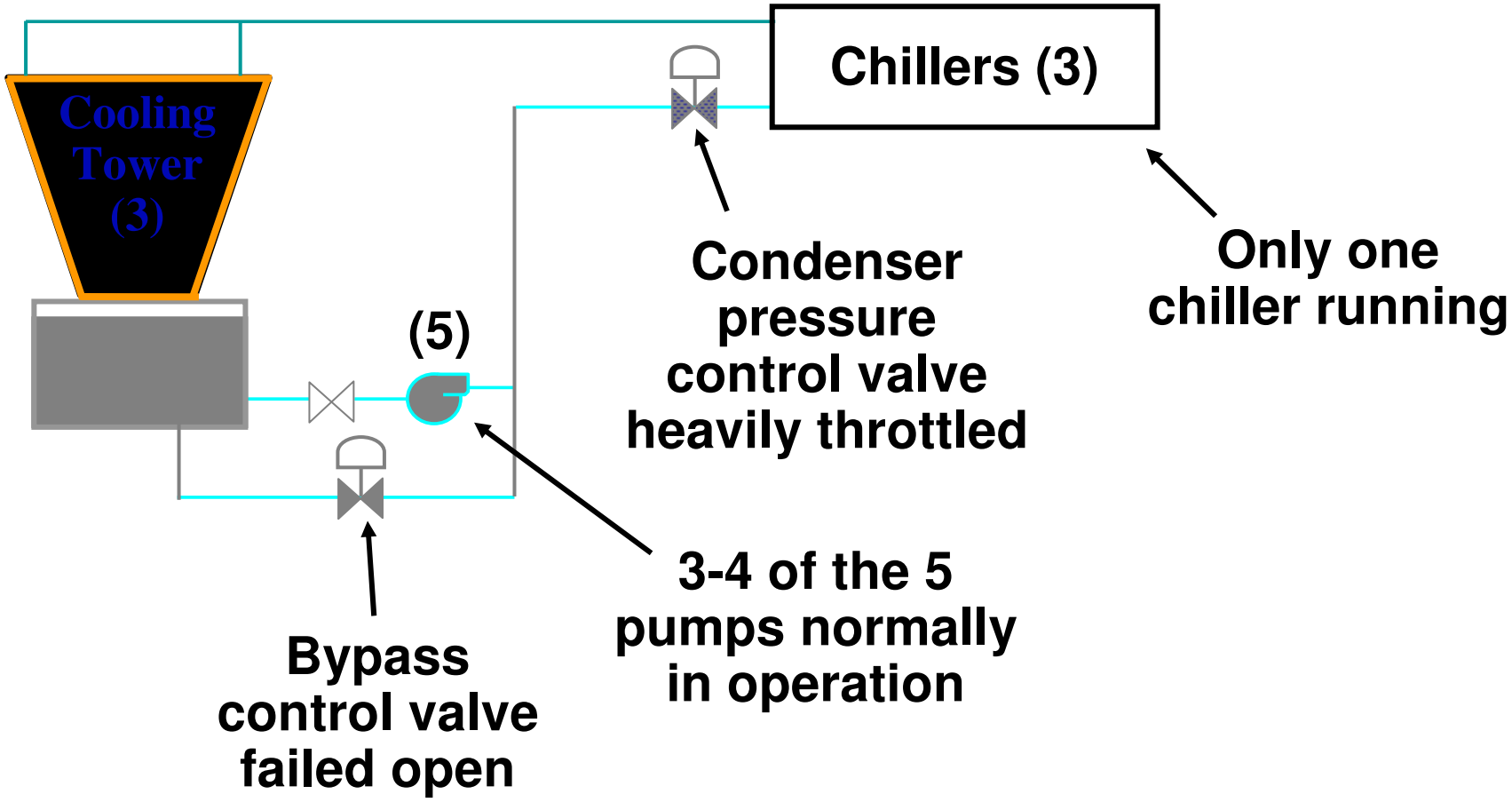
At each interface, there are inefficiencies. The goal should be to maximize the overall cost effectiveness of the pumping, or how much flow is delivered per unit of input energy.

An introduction to the Pumping System Assessment Tool (PSAT)

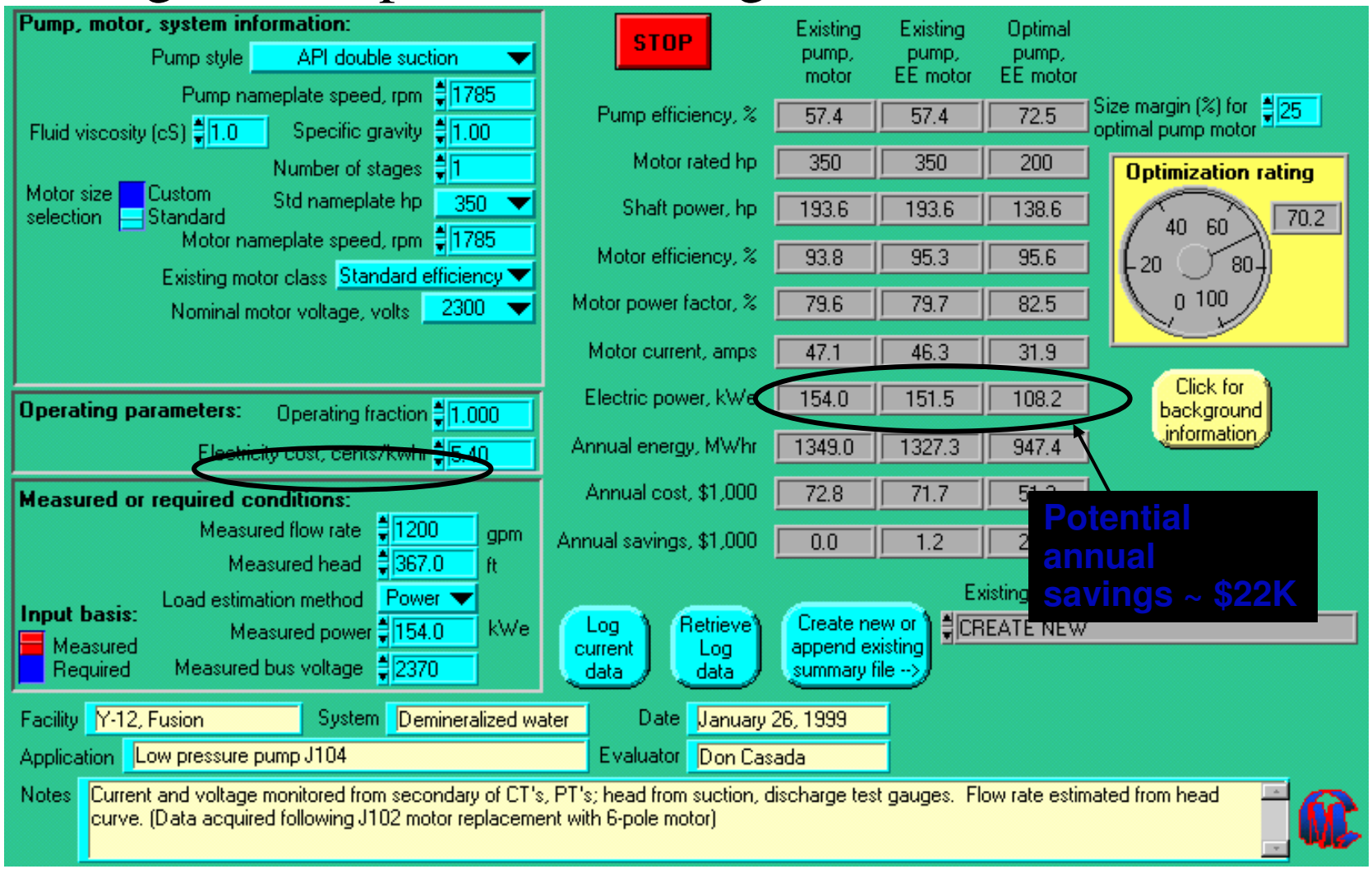
- Goal: to assist pump users in identifying pumping systems that are the most likely candidates for energy and cost savings
- Requires field measurements or estimates of flow rate, pressure, and motor power or current
- Uses pump and motor performance data from Hydraulic Institute standard ANSI/HI-1.3 and MotorMaster+ to estimate existing, achievable performance

Demineralized and tower water pumping station for the Fusion Energy complex

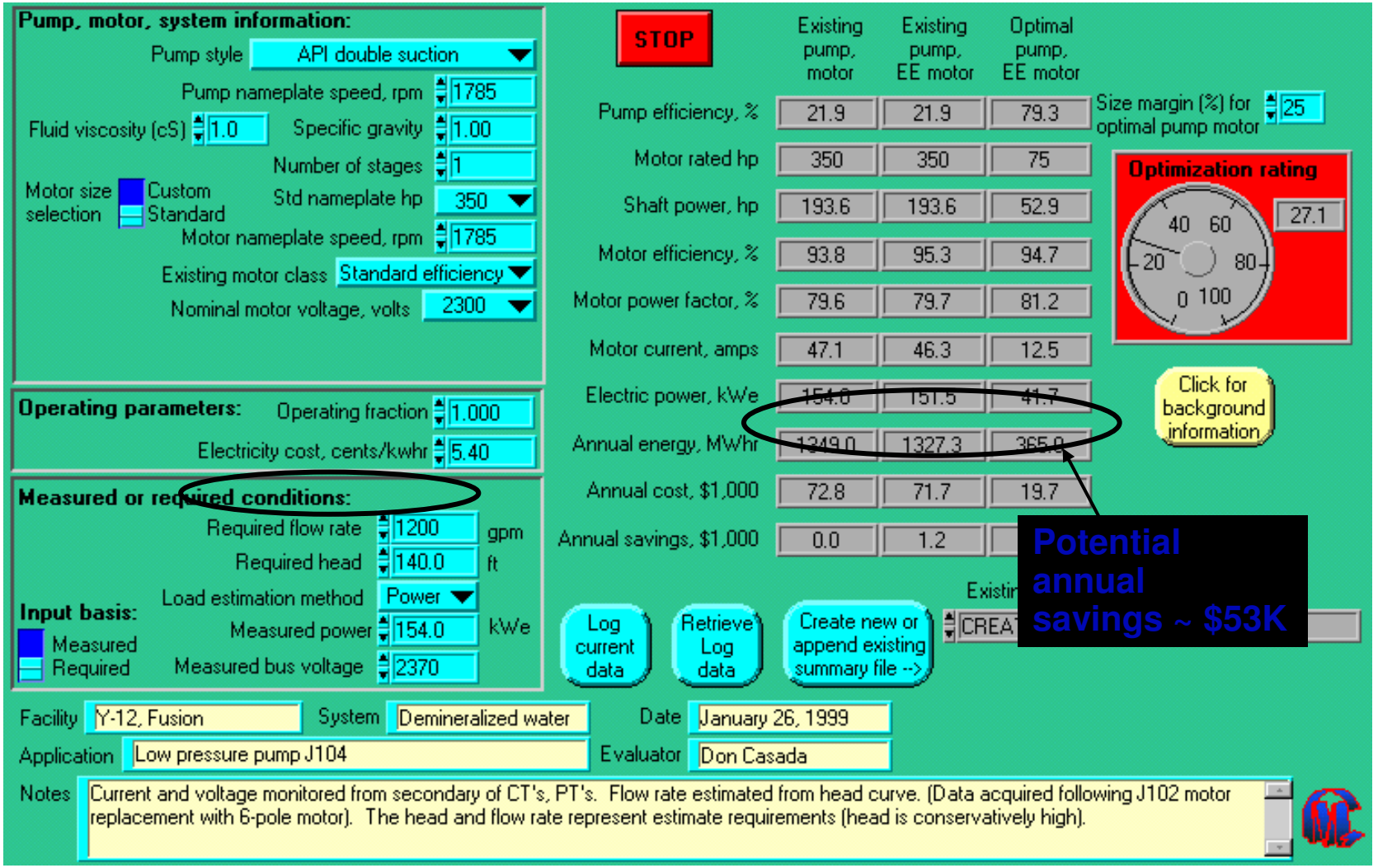
As found conditions: One chiller in operation, but 3or 4 tower pumps running.



Applying the PSAT tool to the measured conditions showed significant potential savings



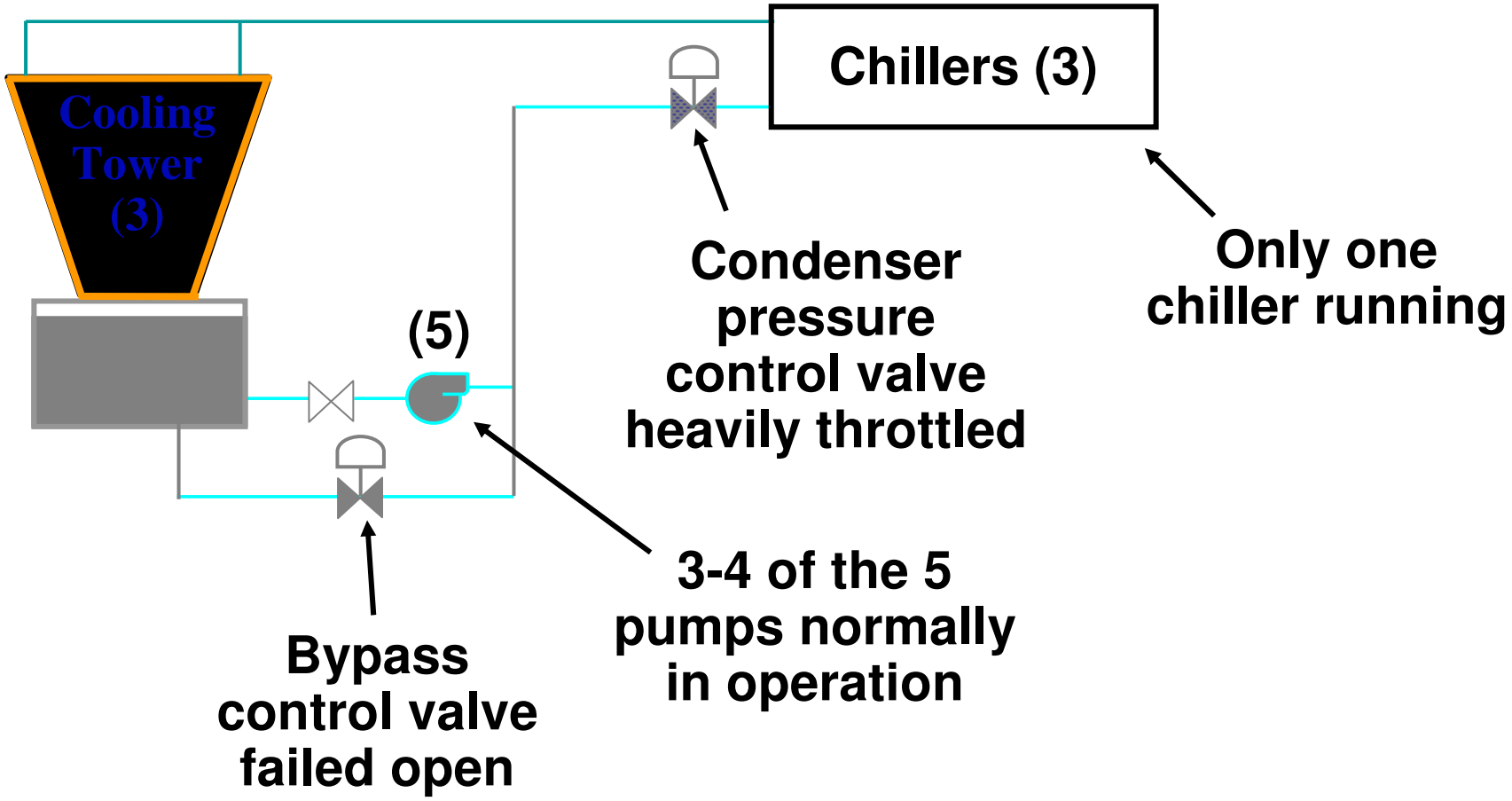
Using the required head estimate instead of the actual operating head could yield much greater savings



Chilled Water System Assessment Tool

- Assesses the efficiency of a chilled water system.

A Chilled Water System



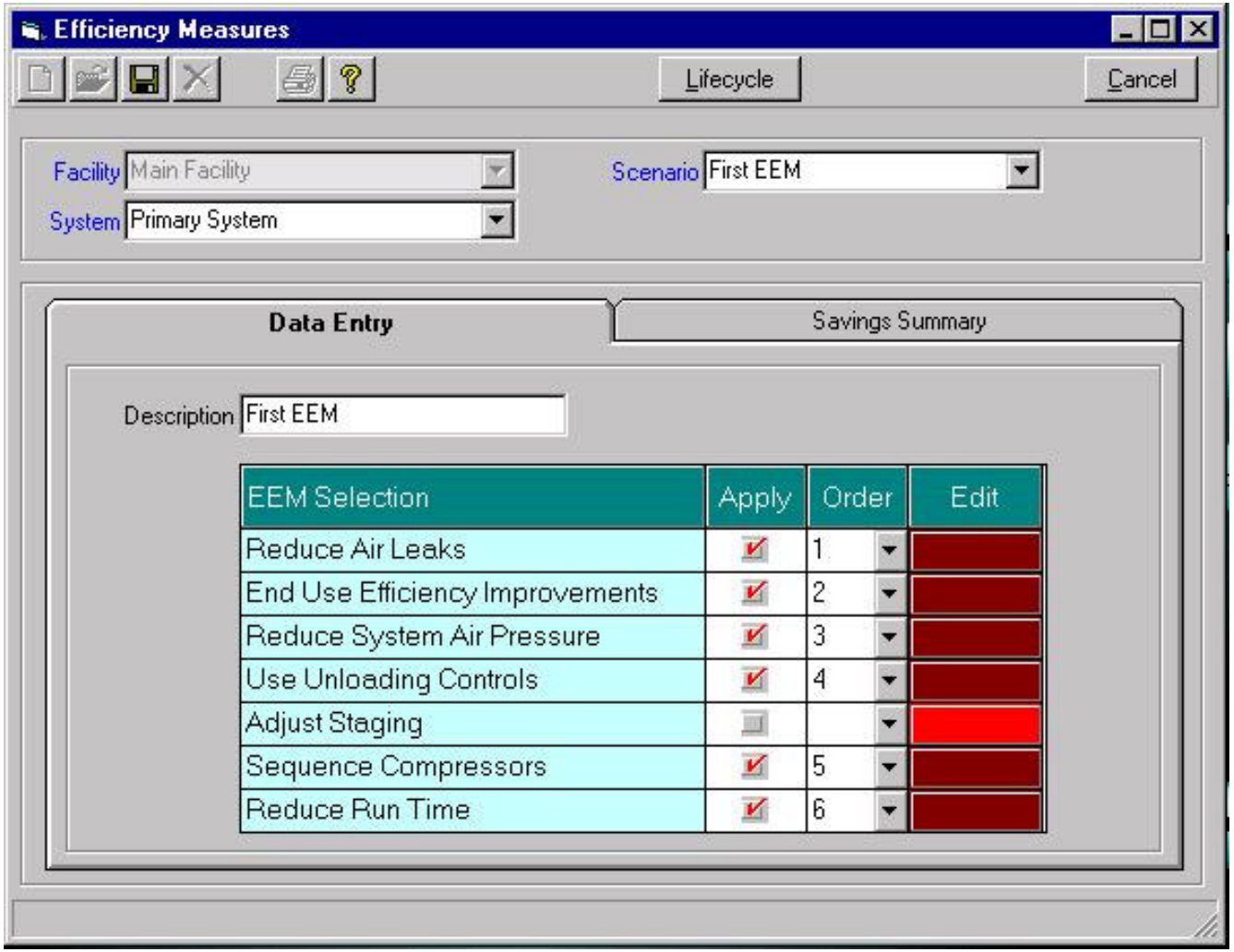
Air Master+: A Compressed Air Systems Assessment Tool

AirMaster

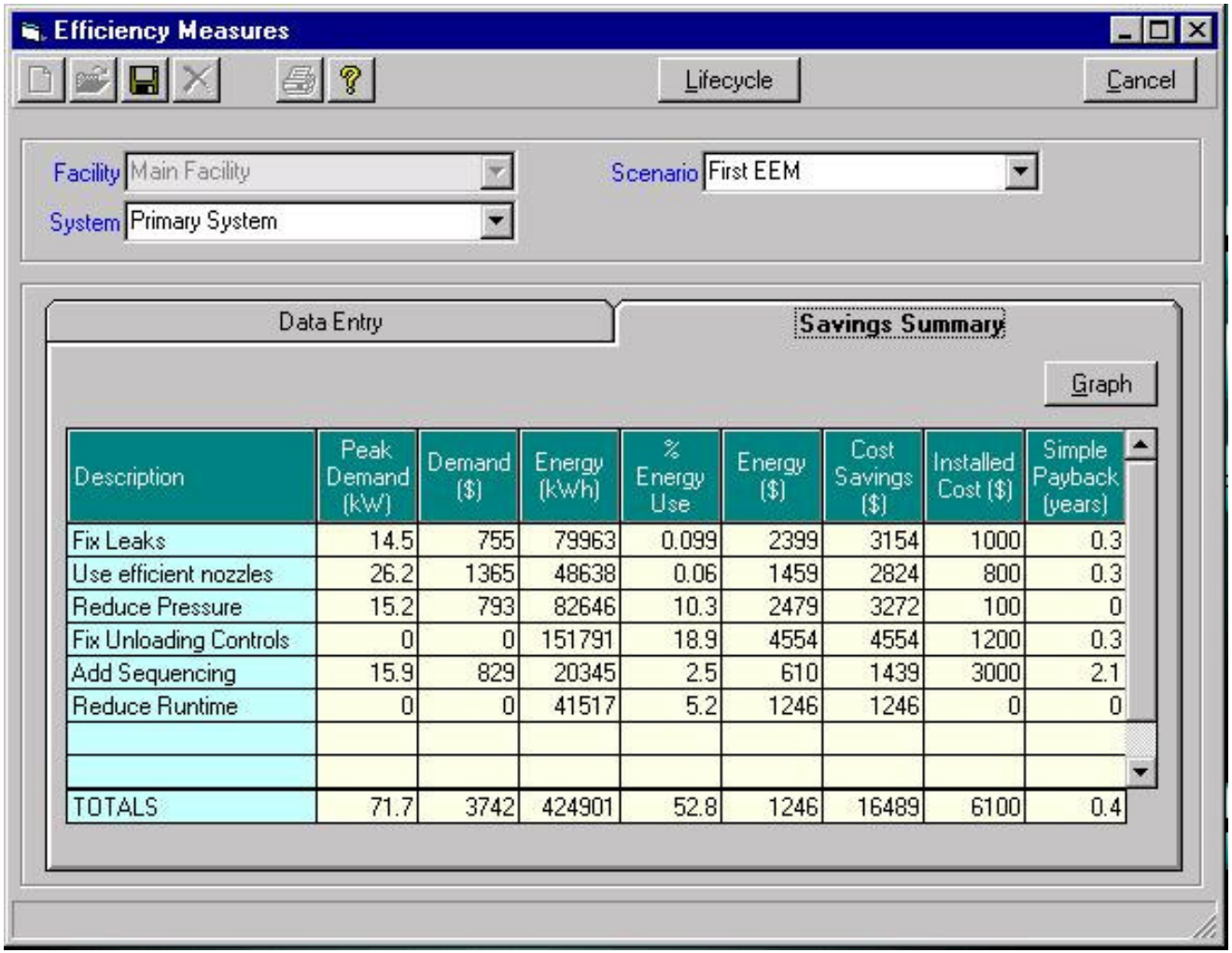
Air Master can be used to baseline a compressed air system and then evaluate the energy savings from seven EEM's:

- Reduce Plant Air Leaks
- Adjust Manual Staging
- Use Unloading Controls
- Reduce System Pressure
- Sequence Compressors
- Reduce Run Time
- Add Primary Storage

Select Energy Efficiency Measures

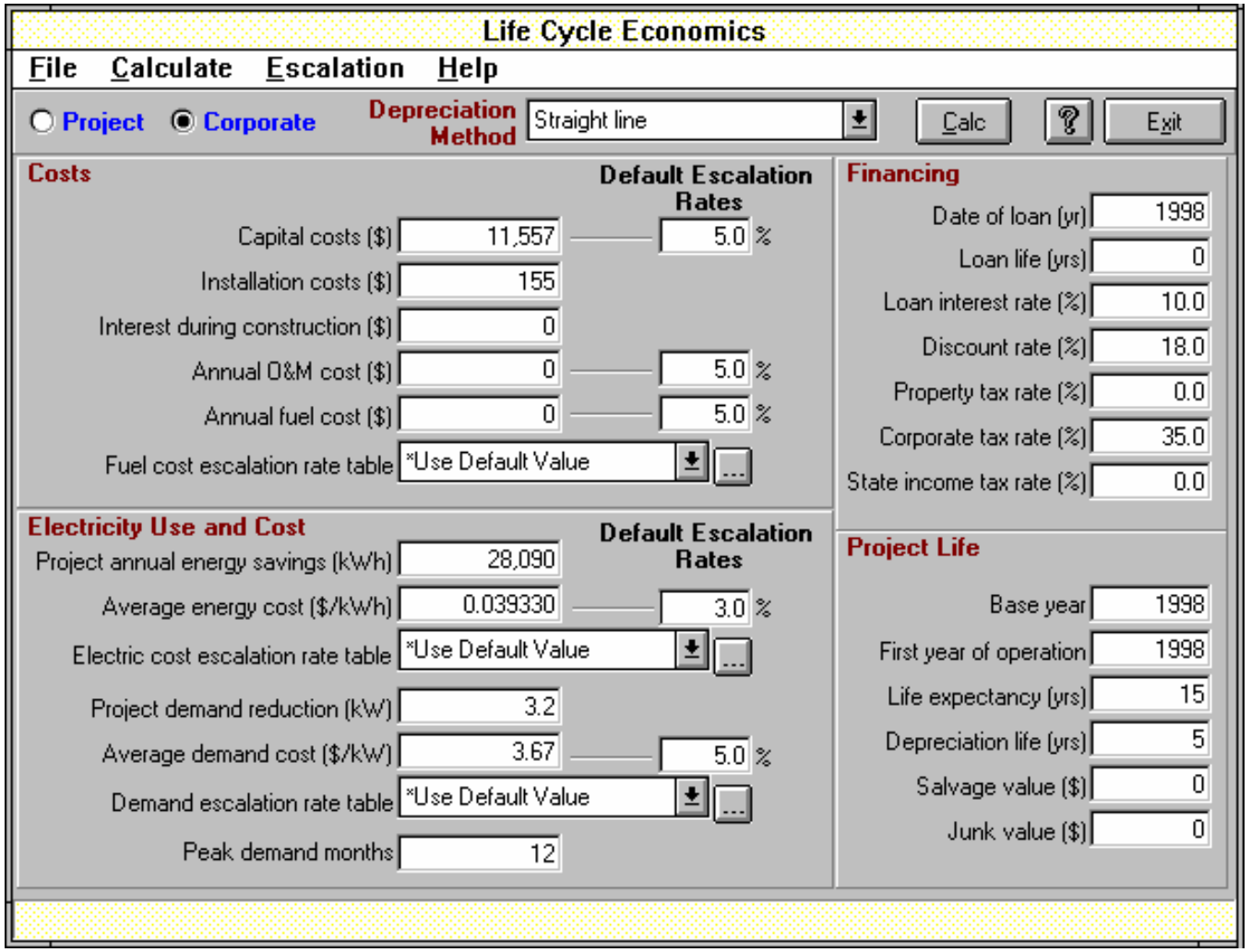


Savings Summary Report

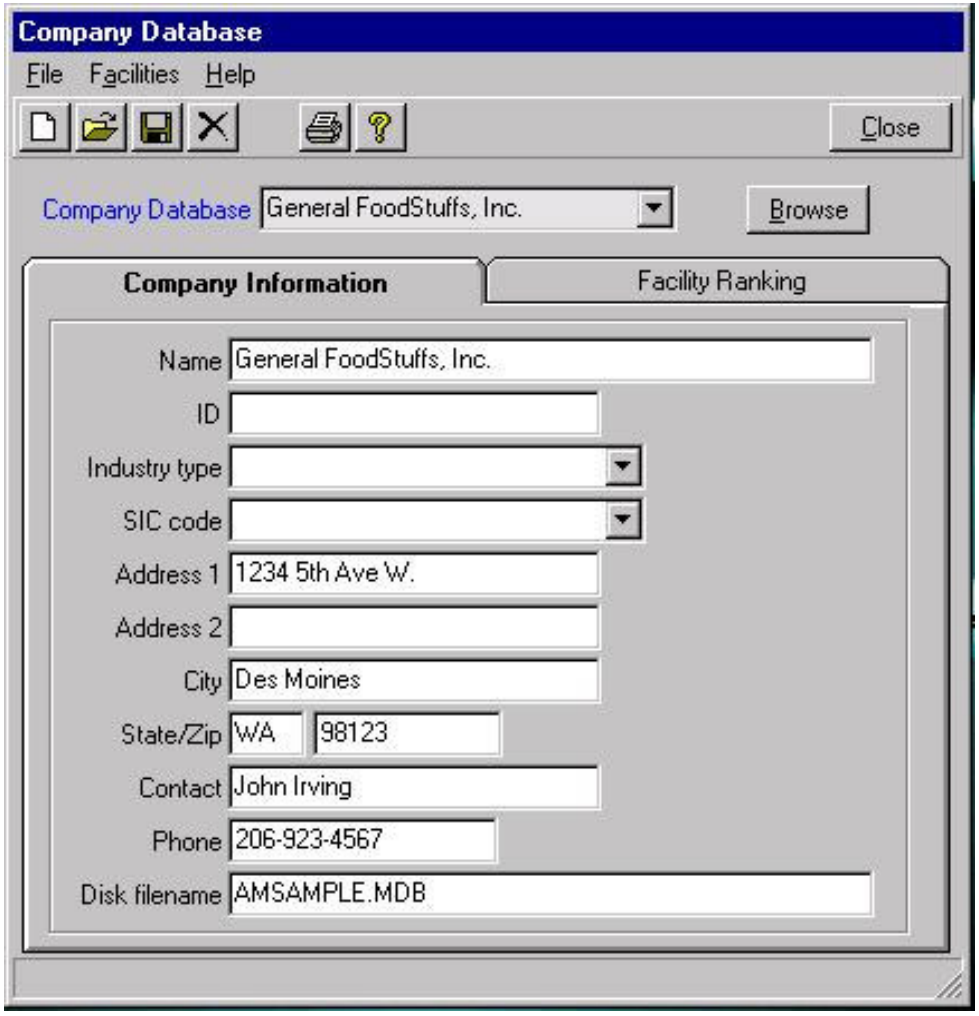


Description	Peak Demand (kW)	Demand ($)	Energy (kWh)	% Energy Use	Energy ($)	Cost Savings ($)	Installed Cost ($)	Simple Payback (years)
Fix Leaks	14.5	755	79963	0.099	2399	3154	1000	0.3
Use efficient nozzles	26.2	1365	48638	0.06	1459	2824	800	0.3
Reduce Pressure	15.2	793	82646	10.3	2479	3272	100	0
Fix Unloading Controls	0	0	151791	18.9	4554	4554	1200	0.3
Add Sequencing	15.9	829	20345	2.5	610	1439	3000	2.1
Reduce Runtime	0	0	41517	5.2	1246	1246	0	0
TOTALS	71.7	3742	424901	52.8	1246	16489	6100	0.4

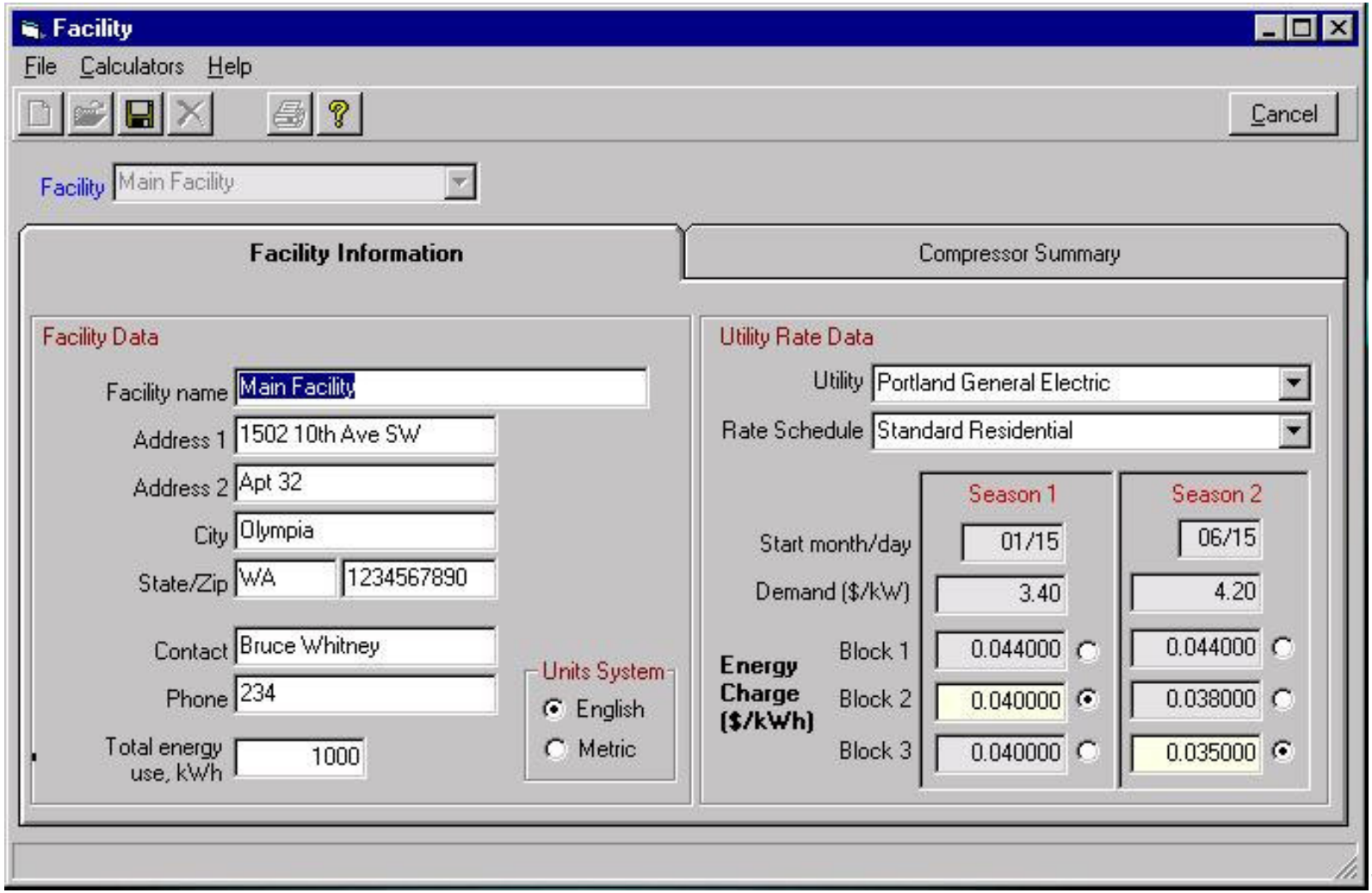
Life Cycle Analysis Setup Screen



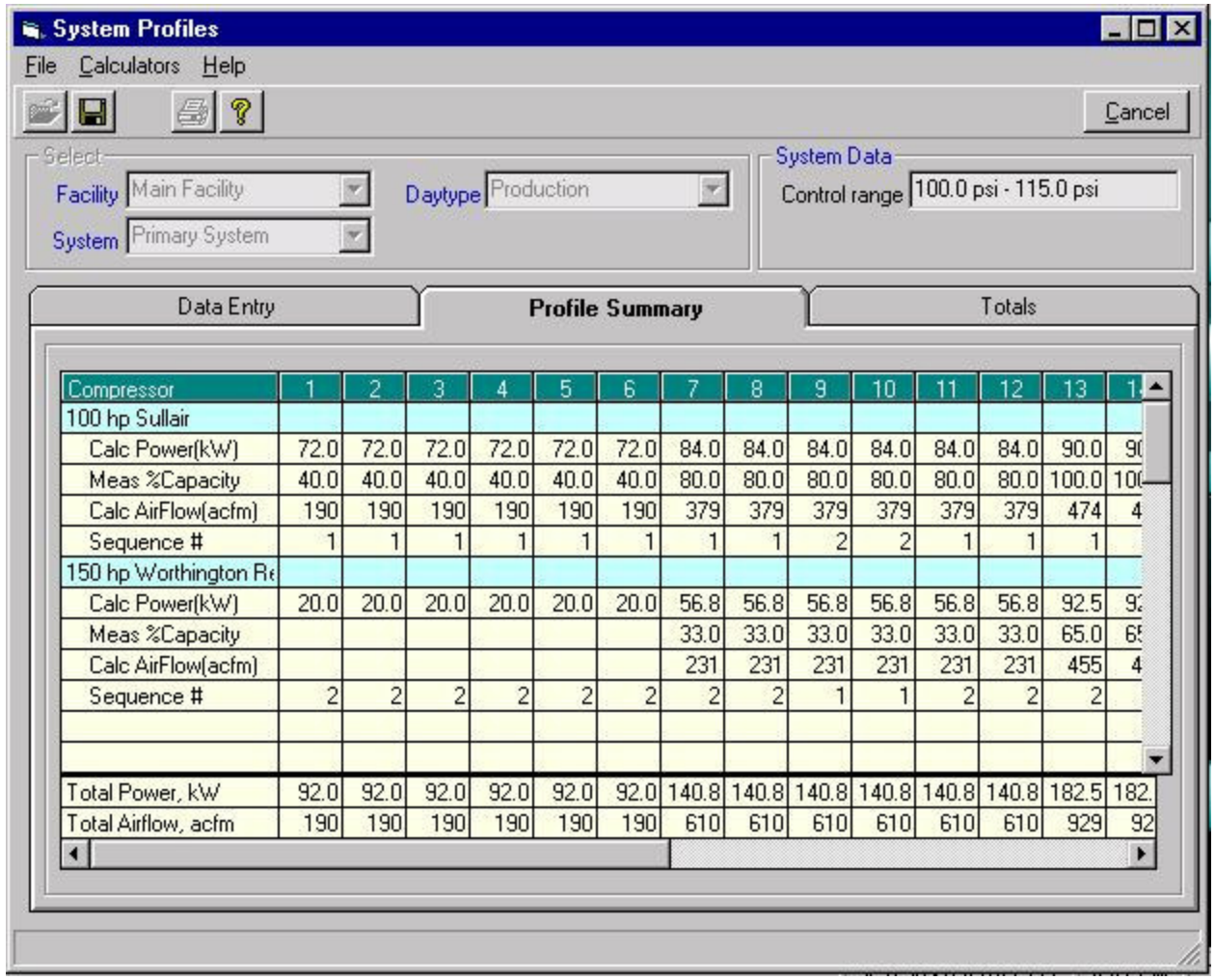
Establish your Company Database



Facility Screen

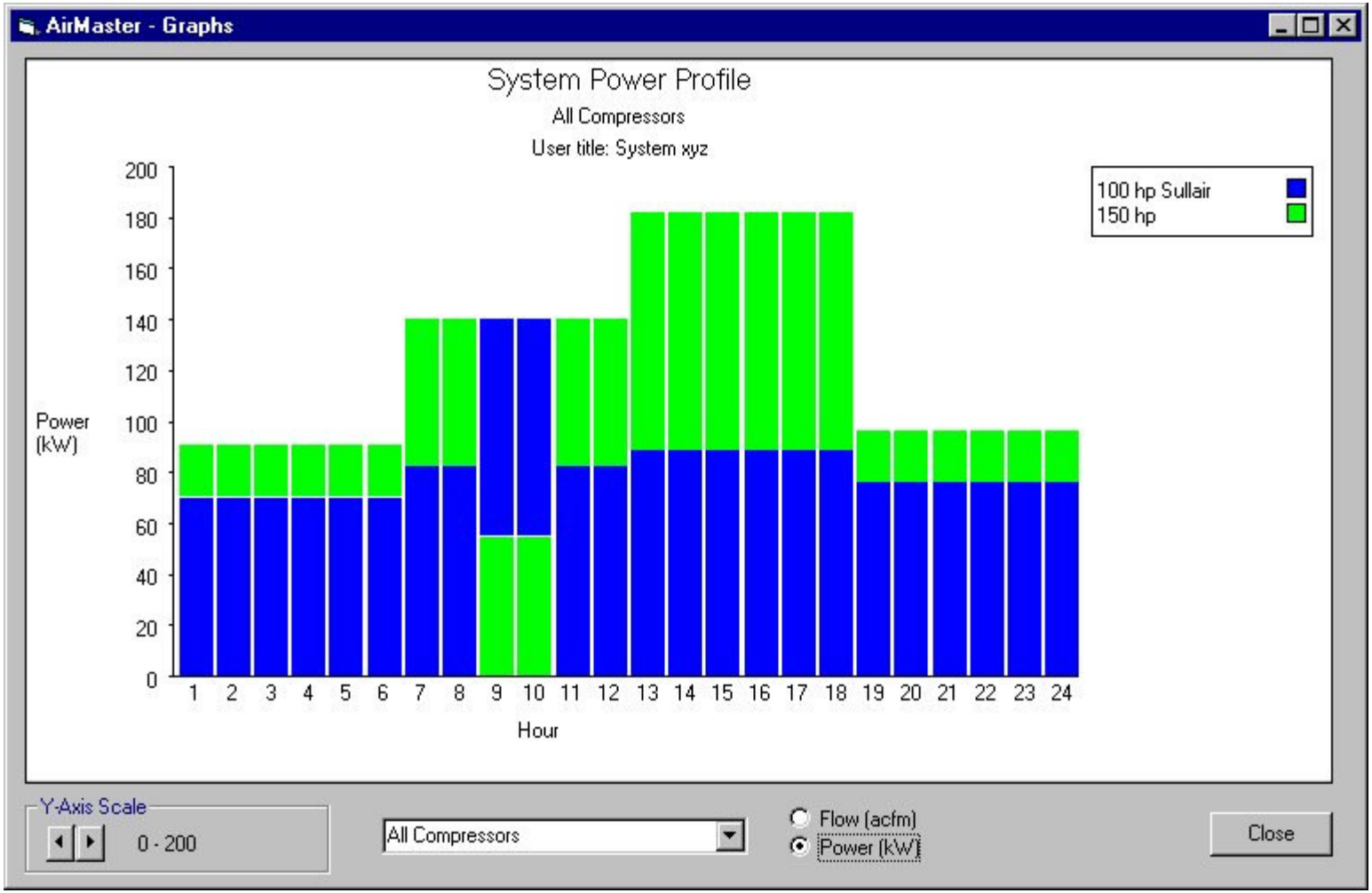


Compressor Operations Summary

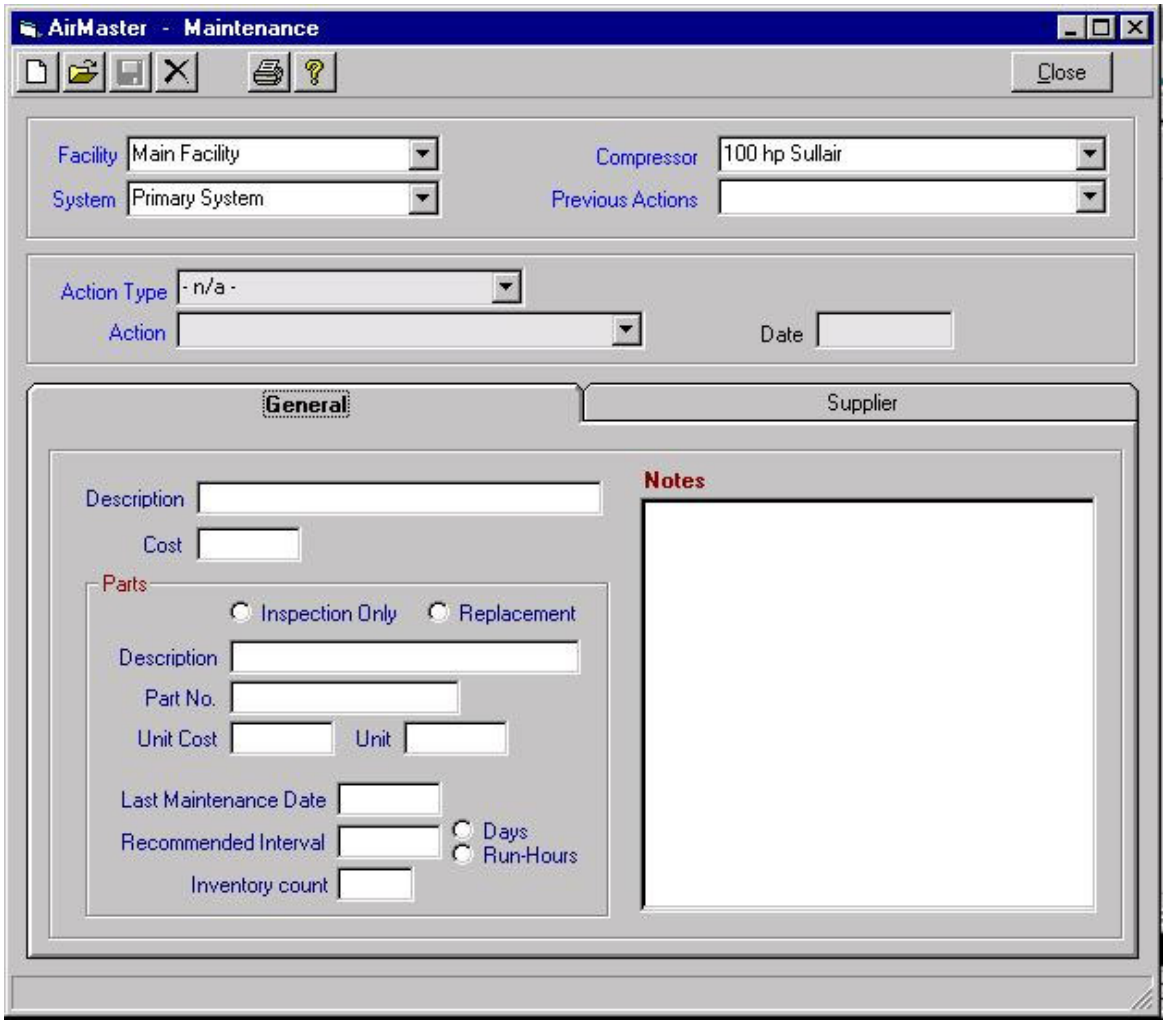


Compressor	1	2	3	4	5	6	7	8	9	10	11	12	13	14
100 hp Sullair														
Calc Power(kW)	72.0	72.0	72.0	72.0	72.0	72.0	84.0	84.0	84.0	84.0	84.0	84.0	90.0	90
Meas %Capacity	40.0	40.0	40.0	40.0	40.0	40.0	80.0	80.0	80.0	80.0	80.0	80.0	100.0	100
Calc AirFlow(acfm)	190	190	190	190	190	190	379	379	379	379	379	379	474	4
Sequence #	1	1	1	1	1	1	1	1	2	2	1	1	1	
150 hp Worthington Re														
Calc Power(kW)	20.0	20.0	20.0	20.0	20.0	20.0	56.8	56.8	56.8	56.8	56.8	56.8	92.5	92
Meas %Capacity							33.0	33.0	33.0	33.0	33.0	33.0	65.0	65
Calc AirFlow(acfm)							231	231	231	231	231	231	455	4
Sequence #	2	2	2	2	2	2	2	2	1	1	2	2	2	
Total Power, kW	92.0	92.0	92.0	92.0	92.0	92.0	140.8	140.8	140.8	140.8	140.8	140.8	182.5	182.
Total Airflow, acfm	190	190	190	190	190	190	610	610	610	610	610	610	929	92

Compressor Load Profile



Create a Maintenance Record



Case Study: Compressed Air System

Lehigh Southwest Cement Company

- Stabilized system pressure, replaced worn compressors with more efficient units, reduced compressed air waste
- System now operates more efficiently with lower compressor capacity and at a lower system pressure
- Improved reliability and eliminated $50,000/tear in emergency compressor rentals

Benefits:

- Annual savings of $90,000 in energy costs plus $59,000 in maintenance
- 175,000kWh saved annually
- Total cost: $417,000 ($90K incentive from SCE
- Simple payback: 20 months

Case Study: Compressed Air System

Visteon Corporation

This manufacturer of a variety of structured metal parts for the automotive industry implemented an ongoing compressed air system leak management program. (Monroe, MI)

Recommendations

- Take 3 reciprocal compressors (totaling 1,550 hp) off line.
- Base load a 2,500-hp centrifugal compressor and use an 800-hp centrifugal compressor for peak needs.

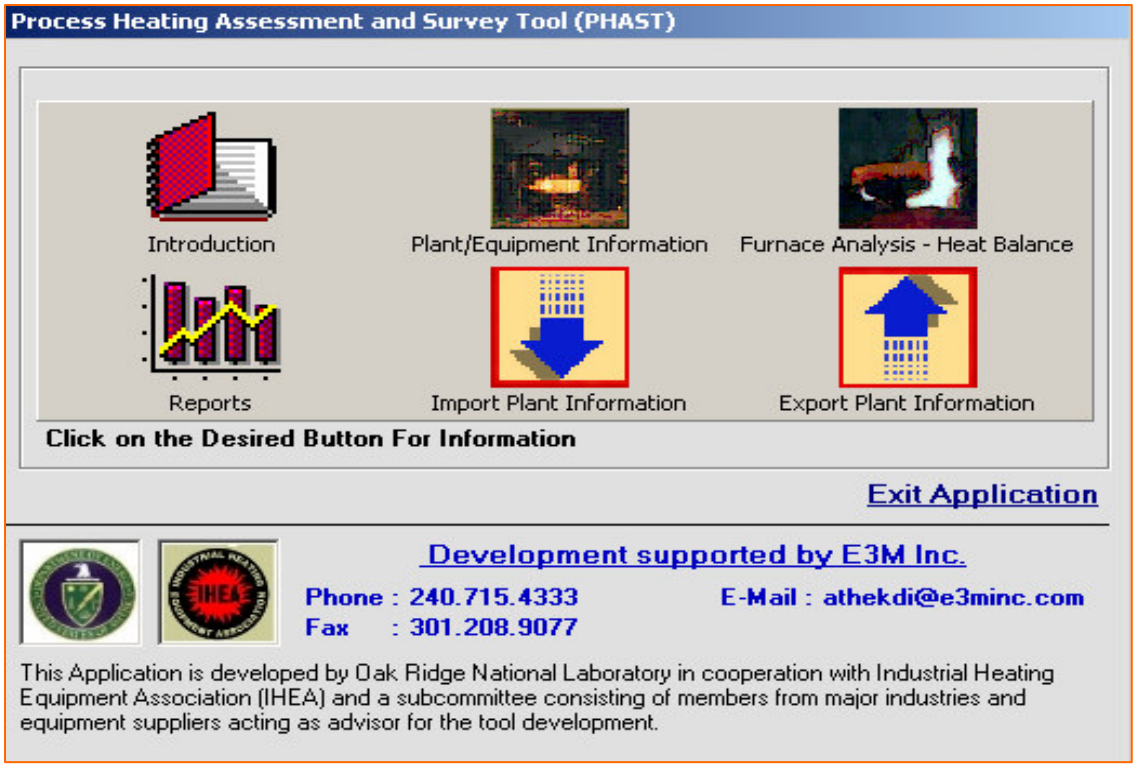
Benefits

- Saves over $560,000 per year in energy costs
- Reduces compressed air use by more than 50% per unit of production

Process Heating Assessment and Survey Tool

Assesses energy use in furnaces/ performance improvements.

Process Heating Assessment and Survey Tool (PHAST)



Process Heating Assessment and Survey Tool (PHAST)

What is PHAST?

- A tool that can be used to:
- Estimate annual energy use and energy cost for furnaces and boilers in a plant
- Perform detail heat balance and energy use analysis that identifies areas of energy use, efficiency and energy losses for a furnace
- Perform "what-if" analysis for possible energy reduction and efficiency improvements through changes in operation, maintenance and retrofits of components/systems
- Obtain information on energy saving methods and identify additional resources

Introduction

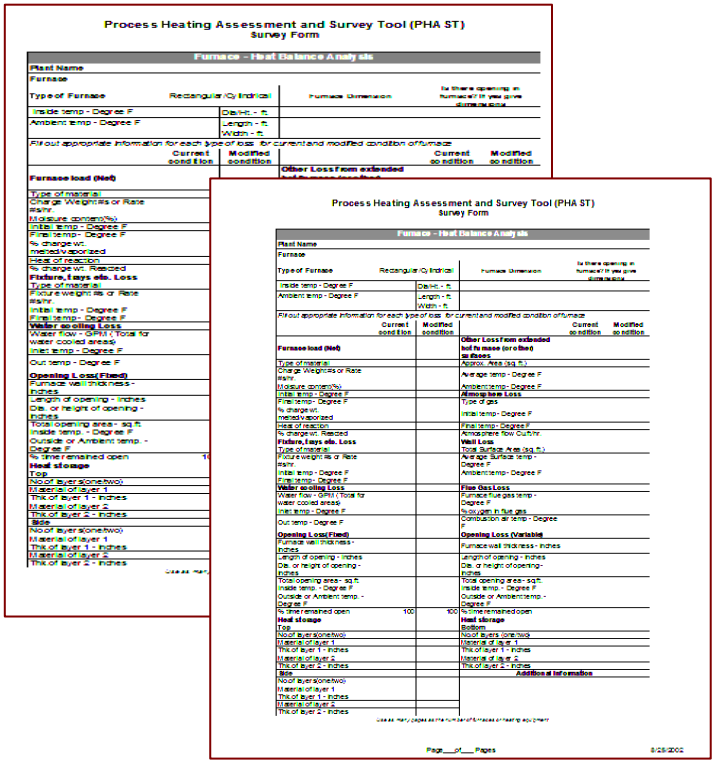
This section includes

- A number of calculators to assess effect of key furnace operating parameters on the furnace performance.
- Resources that provide additional-updated information.
    A. Link to DOE-OIT and IHEA web sites
    B. Glossary of terms used in process heating
    C. Reference material related to process heating

Plant Equipment Information

The **"Plant Information"** section of PHAST is used to survey the process heating (PH) equipment used in a plant, estimate their energy use and cost and compare relative energy cost for all PH equipment.

PHAST Survey Forms


Process Heating Assessment and Survey Tool (PHA ST)
Survey Form

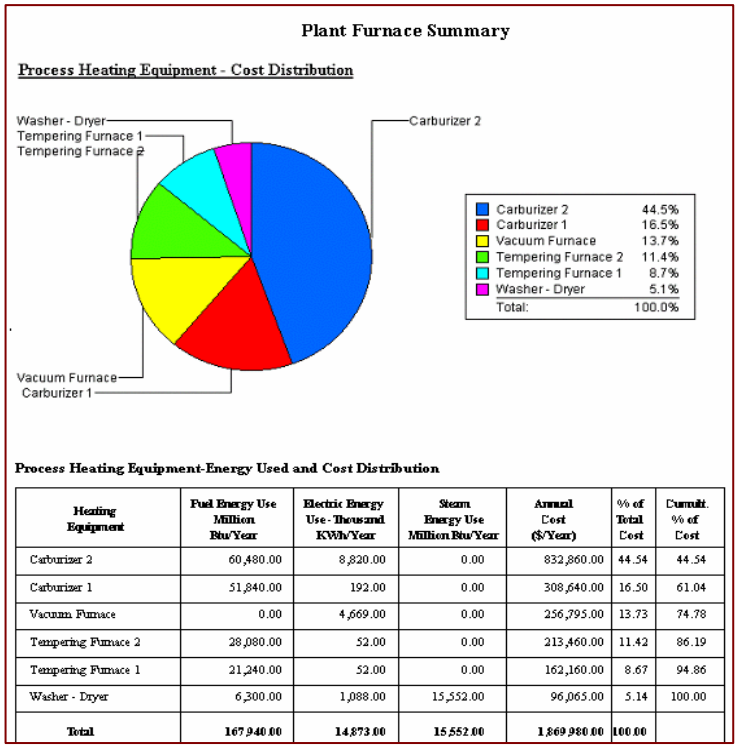
Furnace - Heat Balance Analysis

Plant Name
Furnace
Type of Furnace
Rectangular (Q) Indirect
Furnace Dimension
Is there opening in furnace? If yes give dimension
Inside temp - Degree F
Ambient temp - Dia/Ht. - ft
Length - ft
Width - ft
Fill out appropriate information for each type of loss for current and modified condition of furnace
Current condition
Modified condition
Furnace load (Net)
Type of material
Charge Weight/lbs or Rate #/hr
Moisture content(%)
Initial temp - Degree F
Final temp - Degree F
% charge wt. melted/vaporized
Heat of reaction
% charge wt. Reacted
Fixture, trays etc. Loss
Type of material
Fixture weight lbs or Rate #/hr
Initial temp - Degree F
Final temp - Degree F
Water cooling Loss
Water flow - GPM (Total for water cooled areas)
Inlet temp - Degree F
Out temp - Degree F
Opening Loss(Fixed)
Furnace wall thickness - inches
Length of opening - inches
Dia. or height of opening - inches
Total opening area - sq ft
Inside temp. - Degree F
Outside or Ambient temp. - Degree F
% time remained open
Heat storage
Top
No.of layer s(one/two)
Material of layer 1
Thk of layer 1 - inches
Material of layer 2
Thk of layer 2 - inches
Side
No.of layer s(one/two)
Material of layer 1
Thk of layer 1 - inches
Material of layer 2
Thk of layer 2 - inches
Other Loss From extended hot fa mace (or other) su rfaces
Average Area (sq. ft.)
Average temp - Degree F
Ambient temp - Degree F
Atmosphere Loss
Type of gas
Initial temp - Degree F
Final temp - Degree F
Atmosphere flow Cu.ft/hr.
Wall Loss
Total Surface Area (sq. ft.)
Average Surface temp - Degree F
Ambient temp - Degree F
Flue Gas Loss
Furnace Flue gas temp - Degree F
Flow rate in flue gas
Combustion air temp - Degree F
Opening Loss (Variable)
Furnace wall thickness - inches
Length of opening - inches
Dia. or height of opening - inches
Total opening area - sq ft
Inside temp - Degree F
Outside or Ambient temp - Degree F
% time remained open
Heat storage
Bottom
No.of layers (one/two)
Material of layer 1
Thk of layer 1 - inches
Material of layer 2
Thk of layer 2 - inches
Additional Information
Use as many pages as the furnace/furnaces of heating equipment
Page___of___Pages
8/29/2002

Survey forms are used to collect energy use data for the furnaces, heaters etc.

1. The forms are used to collect information on process heating (PH) equipment energy supply and operating data that needs to be entered in various sections of PHAST
2. The survey forms are given as MS Excel spreadsheets.

Plant Energy Use and Cost Distribution Report*



Plant Furnace Summary

Process Heating Equipment - Cost Distribution

Process Heating Equipment-Energy Used and Cost Distribution

Heating Equipment	Fuel Energy Use Million Btu/Year	Electric Energy Use-Thousand KWh/Year	Steam Energy Use Million Btu/Year	Annual Cost ($/Year)	% of Total Cost	Cumult. % of Cost
Carburizer 2	60,480.00	8,820.00	0.00	832,860.00	44.54	44.54
Carburizer 1	51,840.00	192.00	0.00	308,640.00	16.50	61.04
Vacuum Furnace	0.00	4,669.00	0.00	256,795.00	13.73	74.78
Tempering Furnace 2	28,080.00	52.00	0.00	213,460.00	11.42	86.19
Tempering Furnace 1	21,240.00	52.00	0.00	162,160.00	8.67	94.86
Washer - Dryer	6,300.00	1,088.00	15,552.00	96,065.00	5.14	100.00
Total	**167,940.00**	**14,873.00**	**15,552.00**	**1,869,980.00**	**100.00**	

The report shows

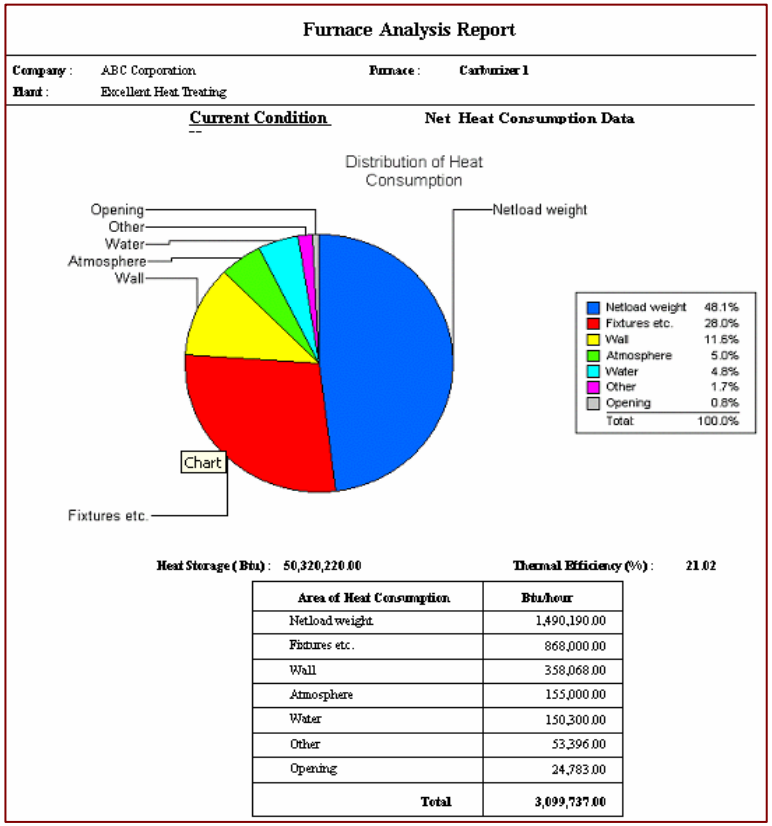
- Estimated annual energy use and estimate annual cost of energy for heating equipment (furnaces, ovens etc.)
- List of heating equipment and % of total energy cost used for each equipment in order of annual cost of energy used.

*** for the Surveyed Process Heating Equipment**

Furnace Heat Balance Analysis

- Analyze the energy used in various parts of a furnace under a given operating condition. The areas for energy use include charge or load, fixtures, trays etc., wall losses, water cooling losses, losses through openings and exposed hot parts, flue products (or exhaust gases) and heat storage.
- This section allows the user to identify major areas of energy use and the magnitude of losses to study the effect of changes in operating conditions and their effect on the energy used in the furnace.

Furnace Heat Balance
Energy Use – Losses Distribution



Furnace Analysis Report

Company : ABC Corporation **Furnace :** Carburizer 1
Plant : Excellent Heat Treating

Current Condition --

Net Heat Consumption Data

Distribution of Heat Consumption

Heat Storage (Btu) : 50,320,220.00 **Thermal Efficiency (%) :** 21.02

Area of Heat Consumption	Btu/hour
Netload weight	1,490,190.00
Fixtures etc.	868,000.00
Wall	358,068.00
Atmosphere	155,000.00
Water	150,300.00
Other	53,396.00
Opening	24,783.00
Total	**3,099,737.00**

The report shows

- **Analysis of energy used in various parts of a furnace under a given operating condition.**

Reports

- This section provides two summary reports in the form of tables and charts.
- The Plant Summary report includes a table of energy used, expected cost of operation for the furnaces surveyed and their comparison.
- The Furnace Analysis report includes a table of energy used in various parts of the furnace analyzed, their relative importance in terms of the percentage of the total energy used and the effect of changes in key operating parameters on energy consumption for the furnace.

Case Study: Process Heating

Weirton Steel, Weirton, WV

Using the ***PHAST*** software, Weirton identified process heating opportunities in the Hot Dip Galvanizing Line and Hot Mill Reheat Furnaces.

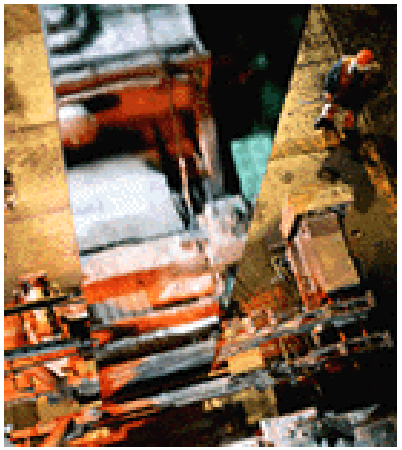


Photo courtesy of Weirton Steel

Recommendations and Benefits

- Seven recommendations, including skid insulation, air-fuel control and slab preheating in reheat furnaces; reuse of reject heat; and direct-fire to replace steam
- Projected savings of $1,500,000 per year

Steam System Assessment Tool

Profiles large steam system

Operations

Management.

Steam System Assessment Tool (SSAT)

- PURPOSE:
  - Demonstrate the magnitude of energy, cost, and emission savings related to specific steam system improvement opportunities

- AUDIENCE:
  - Engineers involved with operation and/or improvement of steam systems

You Can Use SSAT To Evaluate These Key Steam Improvement Initiatives

- Real Cost Of Steam
- Steam Quality
- Boiler Efficiency
- Alternative Fuels
- Cogeneration Opportunities
- Steam Turbines vs PRVs
- Boiler Blowdown
- Condensate Recovery
- Steam Trap Operating Efficiency
- Heat Recovery
- Vent Steam
- Steam Leaks
- Insulation Efficiency
- Emissions Calculations

Key SSAT Features

- Choice of 1, 2, or 3 Header Pressure Models
- Schematics of Model Steam systems
- Estimates of Site Environmental Emissions
- Major Equipment Simulated:
  - Boiler
  - Back pressure turbines
  - Condensing turbine
  - Deaerator
  - Steam traps, leaks, insulation losses
  - Letdowns
  - Flash vessels
  - Feedwater preheat exchangers

Six SSAT Worksheets

- Input
- Schematic of Baseline Model
- Projects Input
- Schematic of Projects Model
- Results
- User Calculations

Next steps

- Attend one-day end-user training to learn capabilities of ITP's software decision support tools and their use
- Or attend qualified specialist training to become a qualified trainer to teach others how to use PHAST. This is a 2 to 2 ½ days course offered at selected locations throughout the country
- Refer to DOE-EERE-ITP web page (www.eere.energy.gov/industry) for schedule and location in your area